# Effects of Breeding for Quality on Alfalfa Ensilability

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## Introduction

Alfalfa is a forage that was once considered difficult to ensile because of its high buffering capacity and low sugar content. However, over the past 30 years alfalfa has been increasingly ensiled rather than stored as hay. The resolution to the problem was wilting the crop sufficiently so that detrimental microorganisms were inhibited by the lower moisture content of the crop as well as by fermentation acids and reduced pH. Tower silos and wilting the crop to at least 40% DM permitted good preservation and promoted the ensiling of alfalfa. Today, more farmers are adopting lower cost methods of ensiling: bunker silos, bags and wrapped bales. In these silos, alfalfa is ensiled at 30 to 40% DM, increasing the opportunity for poor fermentation. In addition, considerable efforts in the seed industry are directed at improving alfalfa quality. It is unclear if these strides to improve quality will adversely affect ensiling. If they do, the newer varieties and wetter silages of today could cause farmers considerable problems. Thus, the objective of this study was to determine if alfalfa lines bred for quality were more difficult to ensile.

## Methods

Eight alfalfa genotypes were established in 8 replicate plots of each in a randomized block design. Four plots were harvested for ensiling at early bud on May 19, and the remainder were harvested at first flower (June 6). In July, regrowth was harvested from both sets of plots. Second regrowth was harvested from the first four plots at early bud on July 13. First regrowth was harvested at first flower on July 6 from the second set of plots. In all harvests, alfalfa was wilted to 35% DM in a greenhouse, chopped in a stationary chopper, inoculated with lactic acid bacteria at 10,000 bacteria/g alfalfa and ensiled, two laboratory silos per plot. At ensiling, samples from each plot were collected for analyzing pH, DM, neutral detergent fiber (NDF), acid detergent fiber (ADF), *in vitro* true digestibility (IVTD), reducing sugars, buffering capacity, nitrogen fractions and morphological stage (mean stage by weight; Kalu and Fick system). After 30 d ensiling, silos were opened and samples taken for analysis of pH, DM, NDF, ADF, IVTD, fermentation products and nitrogen fractions.

## Results and Discussion

The quality characteristics [crude protein (CP), NDF, ADF and IVTD] of the initial forage varied significantly ($P < 0.05$) by genotype (Table 1). The trend of variation was as expected with the high quality lines having higher CP and IVTD and lower fiber contents than the standard lines. There was also significant variation in stage with genotype. However, the most immature and most mature lines were high quality lines, and the standard lines were of intermediate maturity on average. Other factors such as DM content, pH, soluble nonprotein nitrogen (NPN), ammonia nitrogen (NH3), and buffering capacity were unaffected by genotype.

By contrast, all characteristics of the initial forage were significantly ($P < 0.001$) affected by cutting (primary growth*vs.* regrowth), and maturity was similarly significant except for pH ($P = 0.10$). Cutting by maturity interactions ($P < 0.05$) occurred consistently across all characteristics. The only interactions with genotype that were significant ($P < 0.05$) were with maturity for stage and with cutting for DM and NH3. Consequently, differences in initial characteristics among genotypes were generally consistent across harvests.

Characteristics of the silages averaged across harvests are shown in Table 2. There was significant variation ($P < 0.05$) across genotypes for DM, pH, CP, NH3, lactic and acetic acids. However, with the exception of CP, the high quality lines contained both high and low values for each of these constituents. It should also be noted that, despite the significant differences across genotype, the ranges of DMs, pHs, and lactic and acetic acid contents were small and most likely of little practical significance.

Cutting significantly affected all silage characteristics in Table 2 with the exception of NPN. Maturity affected all but NPN and acetic and butyric acids. There were

few interactions: genotype by cutting for DM and cutting by maturity for lactic and acetic acids.

**Conclusions**

Alfalfa genotypes varying in quality produced silages with significantly different fermentation characteristics. However, the magnitudes of these differences were small and not necessarily in an adverse direction for all high quality genotypes. These results suggest that present efforts in breeding for high quality are not having a substantial negative effect on ensiling.

Table 1. Average characteristics of the eight alfalfa genotypes prior to ensiling over four harvests.

| Genotype | Quality | Stage | DM* | pH | CP | NPN | NDF | ADF | IVTD | BC |
|---|---|---|---|---|---|---|---|---|---|---|
| Magnum III | Std. | 2.68 | 33.7 | 6.36 | 20.5 | 17.1 | 43.9 | 34.9 | 73.6 | 570 |
| Pioneer 5373 | Std. | 2.64 | 33.9 | 6.37 | 20.7 | 18.3 | 44.1 | 35.3 | 73.9 | 577 |
| RFV 2000 | Impr'd | 2.58 | 34.0 | 6.34 | 22.5 | 19.9 | 40.8 | 32.5 | 76.5 | 579 |
| Alpha 2001 | Impr'd | 2.72 | 34.2 | 6.34 | 23.2 | 17.9 | 41.0 | 32.6 | 77.3 | 574 |
| Banquet | High | 2.64 | 33.6 | 6.39 | 23.4 | 21.2 | 40.4 | 31.9 | 77.0 | 600 |
| DK 133 | High | 2.71 | 34.1 | 6.35 | 23.5 | 20.1 | 40.1 | 31.8 | 77.6 | 570 |
| WL 252 HQ | High | 2.85 | 33.3 | 6.34 | 24.1 | 17.8 | 40.9 | 32.5 | 78.2 | 591 |
| WL 322 HQ | High | 2.46 | 33.3 | 6.37 | 24.2 | 16.1 | 40.6 | 32.3 | 78.3 | 591 |

*DM - dry matter, %; CP - Crude Protein, % DM; NPN - soluble nonprotein N, % CP; NDF - neutral detergent fiber, % DM; ADF - acid detergent fiber; % DM; IVTD - *in vitro* true digestibility, % DM; BC - buffering capacity, meq/kg DM.

Table 2. Average characteristics of the eight alfalfa genotypes after ensiling over four harvests.

| Genotype | Quality | DM* | pH | CP | NPN | NH3 | Lac | Ace | But | Eth |
|---|---|---|---|---|---|---|---|---|---|---|
| Magnum III | Std. | 32.5 | 5.06 | 24.1 | 56.5 | 8.9 | 5.10 | 2.10 | 0.00 | 0.33 |
| Pioneer 5373 | Std. | 32.1 | 5.06 | 24.0 | 57.8 | 8.8 | 4.74 | 2.12 | 0.04 | 0.44 |
| RFV 2000 | Improved | 33.1 | 5.15 | 24.4 | 57.0 | 8.8 | 4.45 | 2.05 | 0.02 | 0.41 |
| Alpha 2001 | Improved | 33.5 | 5.05 | 24.5 | 55.5 | 8.2 | 4.83 | 1.98 | 0.00 | 0.34 |
| Banquet | High | 32.8 | 5.09 | 25.2 | 54.6 | 8.8 | 4.70 | 2.09 | 0.00 | 0.28 |
| DK 133 | High | 33.1 | 4.97 | 25.5 | 55.3 | 8.4 | 5.24 | 1.98 | 0.00 | 0.35 |
| WL 252 HQ | High | 32.6 | 5.11 | 26.2 | 55.9 | 8.4 | 4.90 | 2.42 | 0.04 | 0.44 |
| WL 322 HQ | High | 32.3 | 5.15 | 24.9 | 57.6 | 9.2 | 4.84 | 2.31 | 0.00 | 0.35 |

*DM - dry matter, %; CP - crude protein, %; NPN - soluble nonprotein N, % CP; NH3 - ammonia N, % CP; Lac - Lactic Acid, % DM; Ace - Acetic Acid, % DM; But - Butyric Acid, % DM; Eth - Ethanol, % DM.